MONTHLY PROGRESS REPORT
SLURRY/MICRO-SURFACE MIX DESIGN PROCEDURE
MARCH 2004

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Contract No.: **CALTRANS 65A0151**
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PROJECT OVERVIEW

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines, and specifications.

Phase I of the project has two major components: 1) the first consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems, 2) the second part of Phase I deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods, evaluate successful constructability indicators, conduct ruggedness tests on recommended equipment and procedures, and prepare a report that summarizes all the activities undertaken under the task.

In Phase III, the project team will develop guidelines and specifications, a training program, and provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a Final Report.

CURRENT MONTH WORK ACTIVITIES AND COMPLETED TASKS

PHASE I—LITERATURE SEARCH AND WORK PLAN DEVELOPMENT

Task 1—Literature Review and Industry Survey

Task 1.1 Literature Review

Completed
The literature review process is completed with all sources of information on the design and use of micro-surfacing and slurry seals reviewed and summarized in Chapter 2 of the Phase I Report. Following is a representative list of references:

ISSA Recommended Performance Guidelines for Slurry Seal Mix Design (A105) and Micro-Surfacing (A143)

- ASTM D3910-98 and ASTM D6372-99 Practice for Design, Testing and Construction of Slurry Seal and Micro-Surfacing respectively
- TTI Reports 0-1289-1 & 1289 2-F
- ISSA Design Technical Bulletins
- ISSA Conference Proceedings
- European Standards EN 12274-1 to 12274-8 Slurry Surfacing Test Methods Part 1 to Part 8.
- Technical Guideline: The use of Modified Bituminous Binders in Road Construction. Asphalt Academy c/o Transportek, CSIR
- Austroads – Guide to the Selection and Use of Bitumen Emulsions
- Micro-Surfacing Pilot Study 2001, Caltrans
- Ministry of Transportation, Ontario: Micro Performance Study
- Friction Evaluation of Slurry Systems in Kansas
- Pennsylvania Department of Transportation Research Report No. 89-61
- FHWA Long Term Pavement Performance (LTPP) SPS-3
- Road Trials of Stone Mastic Asphalt and Other Thin Surfacings, England
- MnROAD 1999 State Micro Surfacing Project
- City of Saskatoon, Saskatchewan, Micro-Surfacing Program

Planned
Although the literature review process is finalized, any new information will be reviewed as it becomes available.

Task 1.2 Industry, Agency, and Advisory Panel Surveys

Completed
Following discussion with members of the team and Caltrans, three surveys were designed:

- Agencies: Those using the AASHTO LISTSERVE link (United States and Canada).

- Contractors and Manufacturers: Those in the United States and the international slurry surfacing and micro-surfacing industry.

- Advisory Panel Contractors.

The three proposed survey questionnaires were included in the August 2003 monthly report and discussed at the videoconference kickoff meeting on September 22, 2003. Based on the comments and suggestions of the participants at the videoconference, the questionnaires were revised and included in final form in the September 2003 monthly report.

The results of the surveys were summarized in the Phase I Report.

Major Conclusions
The major conclusions of the literature search are provided here:

- All the mix design methods currently used by practitioners closely follow the ISSA Guidelines A105 and A143. Minor modifications consist of addition or deletion of certain laboratory tests, according to local agency requirements.

- The design methods for slurry seals and micro-surfacing are very similar; additional tests or test results reflecting higher performance are specified for micro-surfacing.

- The "guideline" character of these methods has a two fold implication: on one hand, it allows the designer to adapt the design to specific project conditions, materials and local agency requirements; on the other hand, designers that do not have extensive experience with similar projects and materials may have difficulties in selecting an optimum design out of a rather wide window of possible designs.

- All methods investigated are rather vague in describing the minimum number of replicate tests, the number of test specimens, and the range of conditions to be used with a specific test (e.g., range of variation in temperature, humidity, soaking time). It would be helpful to provide these details for every laboratory test used as part of the design procedure.

- The repeatability of all recommended laboratory tests should be investigated.

- The great majority of the existing slurry seal and micro-surfacing field projects contain information on the short-term performance of these systems, but very limited or no long-term performance data.

- Project selection and the experience of the construction crew are of crucial importance to the success of micro-surfacing and slurry seal projects.

Task 2—Work Plans for Phases II and III

Completed

The first draft of the Phase II Work Plan has been finalized and is included in Chapter 3 of the Phase I Report. In summary, five mixes will be included in the laboratory testing factorial. The new approach is to measure the mechanical properties of the mixtures throughout the process. This is broken into construction issues and performance issues (short term and long term).

A test developed in Germany is being proposed as the method by which the mixing characteristics are measured. This will measure a profile of cohesion change during mixing allowing a mixability index and a spreadability index to be defined and specified. The apparatus consists of a special impeller mixer that is attached to a strain measurement device and a computer.

It is proposed that the short-term cohesion build be measured by an automated ISSA TB139 wet cohesion test. This will allow a traffic cohesion and early strength cohesion to be defined and specified. Both tests may be done under a range of test conditions. The apparatus is being developed.

Another cohesion type measurement is the French WTAT that uses a wheel assembly instead of a rubber hose. This test is also being developed for long term testing of abrasion resistance of cured materials.

The draft of the Phase III Work Plan has been finalized and is included in Chapter 4 of the Phase I Report.

On February 24, 2004, members of the research team met in San Diego with CALTRANS and members of the panel to discuss the results of the Phase I effort. The team presented the conclusions and findings of the literature search and surveys followed by presentations of the work plans for Phases II and III. The panel made recommendations on the Phase I Report and the Phase II and III work plans.

This Month
The team submitted the final copy of the Phase I Report to CALTRANS early in the Month (March 2004).

PHASE II—MIX DESIGN PROCEDURE DEVELOPMENT

This Month
Members of team discussed the applicability of the Superpave binder classification system to asphalt emulsions used in micro-surfacing and slurry seals. Several issues were identified and will be discussed in a team meeting scheduled for April 15-16 in Sacramento. Some of these issues are:

- The Superpave binder characterization is based on measurements of stiffness and viscosity and evaluates the susceptibility of an HMA mix to low temperature cracking, fatigue cracking, and rutting. Viscosity is used as a measure of workability. Micro-surfacing and slurry seals are very thin layers (<1 in) and, if the original pavement surface is cracked, these cracks will reflect through. If the original surface is not cracked, most likely the micro/slurry will not crack. Instead, abrasion is the most common long-term distress observed on these materials. An abrasion test (like the WTAT) is obviously better suited to characterize the susceptibility of the material to wear than is a stiffness test. In this case, abrasion or cohesion is the “fundamental property” of interest rather than stiffness, which may not be correlated with the susceptibility of a mix to wear.

- Similarly, viscosity would not be enough to evaluate constructability. For micro-surfacing and slurry seals, it is critical to evaluate the mixing time, the time available for spreading and finishing the material, and the build-up of strength with time after placement in order to evaluate when the mix would be able to sustain traffic without damage. Here is where a measure of stiffness would be valuable. However, the stiffness of the mix varies with time as the water is expelled from the emulsion and the mix develops strength. The team will discuss such issues as:

    - Can a binder test characterize this increase in strength with time?

    - Are tests on an extracted binder representative of the behavior of the binder in emulsion?

  - The binders used in developing the Superpave specification were unmodified. Is the specification applicable to polymer-modified binders that are used in micro-surfacing?

  - Are the Superpave aging methods applicable to cold asphalt emulsions?

- A tentative Superpave binder characterization program was drafted and will be discussed in the April 15-16 meeting

Task 3—Evaluation of Potential Test Methods
No Activity

Task 4—Evaluation of Successful Constructability Indicators
No Activity

Task 5—Ruggedness Tests of Recommended Equipment and Procedures
No Activity

Task 6—Phase II Report
No Activity

FUTURE PROJECT ACTIVITIES

PHASE III— PILOT PROJECTS AND IMPLEMENTATION

Task 7—Evaluation of Potential Test Methods
No Activity

Task 8—Workshop Training Program/Pre-Construction Module
No Activity

Task 9—Pilot Projects/Procedure Validation
No Activity

Task 10—Final Report
No Activity

NEXT MONTH'S WORK PLAN

The activities planned for next month are listed below.

- Coordinate with CALTRANS personnel on an as-needed basis.
- Meet in Sacramento to discuss and plan activities for Phases II and III.
- Proceed with Phase II and Phase III activities.

PROBLEMS / RECOMMENDED SOLUTIONS

No problems were encountered during last month and none are anticipated next month.